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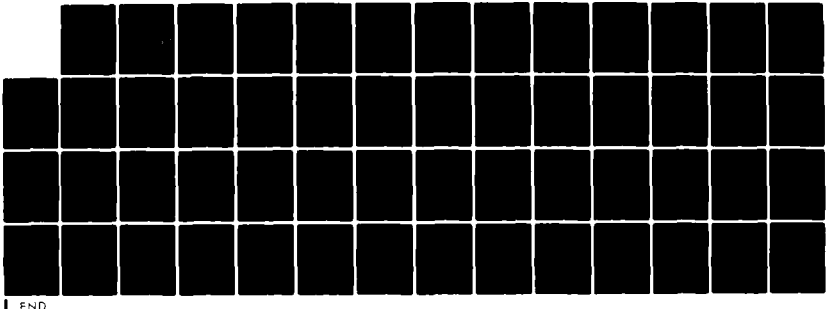

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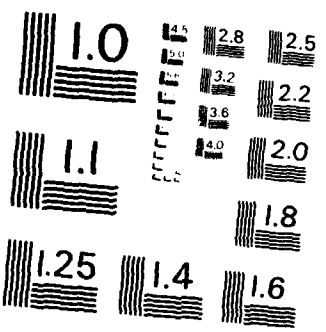


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# Causal versus Diagnostic Contingencies:
# On Self-Deception and On the Voter's Illusion

George A. Quattrone and Amos Tversky

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Running head: Diagnostic Contingencies.

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## Abstract

Two experiments were conducted to test the notion that people select actions that are diagnostic of favorable outcomes even though the actions do not cause those outcomes. In the first experiment, subjects immersed their forearm into a chest of circulating cold water before and after physical exercise. Depending on condition, subjects learned that a long life expectancy was associated either with increases or decreases in tolerance to cold water after the exercise. As predicted, subjects showed changes in tolerance on the second trial in the direction correlated with a long, healthy life. In the second experiment, subjects encountered one of two theories about the sort of voters who determine the margin of victory in an election. Only one of the theories would enable voting subjects to imagine that they could "induce" other like-minded persons to vote. As predicted, more subjects indicated that they would vote given that theory than given a theory in which the subject's vote would not be diagnostic of the electoral outcome, although the causal impact of the subject's vote is the same under both theories.

# Causal versus Diagnostic Contingencies:

# On Self-Deception and On the Voter's Illusion

George A. Quattrone & Amos Tversky

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Decision-making is a risky enterprise. The outcome of a decision often depends on past or future states of nature that cannot be known with certainty. Because a decision may have a wonderful or a disastrous outcome depending on which state of nature obtains, it is reasonable for the decision-maker to weigh the possible outcomes of an action by the probability of the states on which the outcomes depend.

In many situations, the relevant states of nature are independent of one's choice. Despite numerous anecdotes to the contrary, the probability of rain does not depend on whether one has decided to wash one's car. We shall use the conventional notation for conditional probabilities, P(S/A), to refer to the probability of a state, S, given act, A. Thus, the state 'rain' is independent of the act 'car wash' in the sense that P(S/A) = P(S/not A) = P(S), the marginal (i.e. predecisional) probability of rain.

It is not always true that the relevant states of nature are independent of one's choice. In deliberating over whether to stop smoking, for example, the decision-maker must weigh the pleasures of tobacco and the pain of withdrawal against the possibility of premature death. Clearly, the risk of contracting lung

cancer (S) is not independent of whether one abstains (A) from smoking in that P(S/A) < P(S/not A). Because states may not be independent of one's choice, the value of each outcome associated with a particular act should be weighted by the probability of the outcome conditional on selecting the act (Jeffrey, 1965).

This conception becomes problematic when it is recognized that acts may be *causal* or *diagnostic* of outcomes with which they are correlated. Consider the historical controversy over how to interpret the correlation between smoking and cancer. It is now widely acknowledged that smoking has a direct causal effect on the etiology of lung cancer. But it has not always been so clear. As late as 1959, R.A. Fisher, the great statistician, argued that the correlation could be attributable to a genetic trait that predisposed the individual towards both smoking and cancer. To Fisher, smoking was diagnostic of lung cancer, not causal, in that smoking was merely a sign that the individual had been born with the precancerous gene. Despite the fact that smoking may have a lower expected desirability than abstaining if the value of the outcomes are weighted by the respective conditional probabilities, Fisher cited his genetic thesis as reason enough for lighting up.

One may certainly object to Fisher's theory about the linkage between smoking and cancer. But if the theory were true, Fisher's decision to continue smoking is defensible. According to this theory one either has or does not have the precancerous gene, and hence one's decision to smoke or not does not facilitate nor inhibit the emergence of cancerous cells. True, smokers are more likely

to die of cancer than nonsmokers. But the correlation is channeled through the presence or absence of a genetic trait beyond the individual's control.

One way to conceptualize the problem is to imagine that the hypothetical precancerous gene exerts its influence on smoking by first producing a yen or an urge to smoke (Jeffrey, 1981). The knowledge that one does not have the urge (A*) or that one does (not-A*), effectively 'screens off' the correlation between the act of smoking (not-A) and cancer (S), in the sense that $P(S/A \& A^*) = P(S/\text{not } A \& A^*) < P(S/A \& \text{not } A^*) = P(S/\text{not } A \& \text{not } A^*)$. The inequality indicates that among people without the urge and among people with the urge, smoking is independent of cancer. The overall correlation between smoking and cancer is merely a consequence of there being more smokers and precancerous persons among people with the gene-induced urge than among people without the urge. Hence, upon recognizing that one has the urge to smoke, one who subscribes to Fisher's theory ought to light up because, given the urge, cancer is independent of smoking. Most philosophical analyses of the problem (Nozick, 1969; Gibbard & Harper, 1978; Skyrms, 1980; Jeffrey, 1981) defend smoking under the above assumptions, but question whether it is always possible to screen off the correlation between action and outcome.

We now turn from the logical to the psychological analysis, which is complicated by the fact that causal and diagnostic contingencies are usually confounded in the real world. Suppose undergraduates know that students who attend a review session for the final exam get better grades than students who do

not attend. Does the correlation between attendance and grade mean that the review session really helps? Or does it mean that reviews are attended primarily by conscientious students who would do well session or no? Insofar as there is uncertainty about the causal or diagnostic significance of the action (attendance) with respect to the outcome (grade), it is reasonable for students to entertain the causal hypothesis, play it safe, and attend the session. We hypothesize, however, that people would select an action correlated with an auspicious outcome even if they believed that the action is only diagnostic of the outcome and in no way causal. Thus even if students were presented with compelling evidence that review sessions have no causal influence on their exam performance, and they accept the evidence, they might nonetheless be tempted to attend, so long as better grades are associated with attendance than with non-attendance.

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Insert Figure 1 about here

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This problem is reminiscent of the well-known dilemma faced by Calvinists, who subscribe to divine predetermination. As drawn in the lefthand side of Figure 1, Calvinists believe that there are two kinds of people, the chosen and the non-chosen. Whether one is chosen or not has already been decided by the deity prior to one's birth. There are at least two consequences of the deity's decision. First, the chosen will enter paradise after death, whereas the non-chosen will suffer eternal damnation in hell. Second, the chosen will lead a life of virtue, whereas the non-chosen will lead a life of sin. Calvinists do not know who among

them are the chosen. But they know that avarice, lust, and sloth are sinful acts correlated with eternal damnation. Conversely, they know that charity, purity, and hard work are virtuous acts correlated with eternal post-mortal bliss. Although the acts are not believed to influence one's posthumous fate, most Calvinists conclude that they had better live by the *Book* in that the immediate gratifications of the flesh seem hardly worth an eternity in hell. That Calvinists may confuse diagnostic and causal contingencies is illustrated by the following letter circulated by Baptists in 1770: "Every soul that comes to Christ to be saved ... is to be encouraged ... The coming soul need not fear that he is not elected, for none but such would be willing to come."

What about the 'urge' or the temptation to sin? Do Calvinists not recognize that temptation itself should screen off the correlation between the virtuousness of one's act and the location of one's life after death? After all, only the non-chosen would even contemplate a dissolute deed. The normative analysis of Fisher's smoking theory would suggest that Calvinists ought to transgress upon experiencing the desire to do so, *ceteris paribus*, for heaven and hell are independent of action conditional on the urge to sin. Contrary to this analysis, we believe that many Calvinists would nonetheless resist the temptation and choose instead the virtuous acts correlated with paradise.

The notion that people select actions enabling them to make favorable diagnoses about their own characteristics, such as being chosen, is familiar to social psychologists (see, Abelson et al., 1968). What has not been investigated in

the literature are the conditions under which people would be "taken in" by their own actions. How could actors reasonably make a favorable diagnosis from their behavior when the behavior was enacted in order to make the diagnosis? What comfort could a Calvinist derive from a virtuous act if performed while one is tempted to sin? One possibility is that people do not quite recognize that for diagnostic contingencies the urge to act (e.g., to smoke or to sin) screens off the correlation between action and outcome. People may adopt a quasi-behavioristic doctrine in which actions speak louder than urges and related inner states. This account is consistent with Bem's (1972) theory of self-perception in that inferences about the self are assumed to be based solely on the observation of one's own behavior and on the external circumstances in which one behaves. It is also possible, however, that a certain degree of self-deception may contribute to accepting the diagnosis implied by one's behavior. That is, actors may have to avoid admitting to themselves that the behavior was produced more by the motive to infer an auspicious antecedent cause than by the auspicious antecedent cause itself. Calvinists may deny their temptation to sin and convince themselves that the virtuous act was not selected merely to defend against the inference of not being chosen.

Gur and Sackheim (1979) have characterized self-deception by the following criteria: (a) the individual simultaneously holds two contradictory beliefs, (b) the individual is not aware of holding one of the beliefs, and (c) the lack of awareness is motivated. We are arguing that when people select actions to infer

an auspicious antecedent cause, then, to accept the inference as valid, they often render themselves unaware of the fact that they selected the action just in order to infer the cause. Unless they deny to themselves that their action was purposefully chosen to make a favorable diagnosis, they may not attribute the action to the target antecedent cause but rather to the motive to infer that cause. This view is compatible with the criteria put forth by Gur and Sackheim. The beliefs, "I purposefully engaged in the behavior to make a favorable diagnosis," and "I did not purposefully engage in the behavior to make a favorable diagnosis," are clearly contradictory (a), and one's lack of awareness (b) regarding the former belief is motivated by the individual's desire to accept the diagnosis implied by behavior (c). When people select an action to make a favorable diagnosis, but fail to realize that they purposefully selected the action in order to make the diagnosis, we classify the action and the denial collectively as a form of *deceptive diagnosis*.

## EXPERIMENT 1

### *Deceptive Diagnosis about One's Own State of Health*

The first experiment tested our basic thesis that people select actions diagnostic of favorable outcomes, even if it is clear that the action does not facilitate the outcome. Self-report measures were also included to test the notion that, even if people do engage in the diagnostic behavior, the favorable diagnosis would

be made primarily by subjects who deny that the action was purposefully selected. We chose to investigate these issues in a medical context. Medical examinations consist of tests that are diagnostic or indicative of one's underlying state of health. How one does on the examination does not, in general, affect one's state of health. Rather, it is one's state of health that determines how one does on the examination. If people were given an opportunity, we predict that they would "cheat" on a medical examination in a direction correlated with desirable outcomes, such as good health and longevity. To test this hypothesis, we constructed an analogue of the Calvinist dilemma in the medical realm. Subjects learned that there were two kinds of hearts, namely, Type 1 and Type 2. Heart type allegedly had two sets of consequences. First, people with Type 1 heart are frequently ill, are prone to heart disease, and have a shorter than average life expectancy. People with Type 2 heart enjoy good health, have a low risk of heart disease, and show a longer than average life expectancy. Second, heart type was said to determine how exercise would change an individual's tolerance to cold water. Half of our subjects were informed that a Type 1 heart would increase tolerance to cold water after exercise whereas a Type 2 heart would decrease tolerance. The remaining subjects learned that a Type 1 heart would decrease tolerance to cold water after exercise, whereas a Type 2 heart would increase tolerance. We shall refer to these treatments as the Decrease and Increase conditions, respectively, to indicate the change in tolerance associated with good health and longevity. The righthand side of Figure 1 illustrates the correlational structure received by subjects in the Decrease condition. All three

variables (i.e., heart type, life expectancy, and shifts in tolerance) were treated as continuous. For example, subjects in the Increase condition were led to believe that the closer they are of having a Type 2 heart, the more would exercise increase their tolerance and the longer would their life-expectancy be.

Subjects first underwent a baseline trial of the cold-pressor pain task (Hilgard et al., 1974), which requires them to submerge their forearm into a chest of circulating cold water until they can no longer tolerate it. Subjects then pedaled an exercycle for one minute, which was followed by the information about heart types, life expectancy, and tolerance shifts. Subjects then repeated the cold-pressor task to their tolerance threshold in the presence of a second "blind" experimenter. Finally, subjects indicated on a questionnaire whether they believed they were Type 1 or Type 2 and whether they had purposefully tried to alter the amount of time they kept their arm in the water on the post-exercise trial. We tested the following three hypotheses:

1. On the post-exercise or "experimental" trial, subjects would shift their tolerance threshold in the direction correlated with health and longevity: that is, a downward shift in the Decrease condition and an upward shift in the Increase condition. The prediction for the Increase condition is especially noteworthy because it implies that people will incur painful consequences of their action so long as the action were diagnostic of an outcome more important than transient pain.

2. By and large, subjects will deny that they purposefully tried to shift their tolerance on the post-exercise trial.

3. Those subjects who do admit that they had purposefully tried to shift their tolerance would be less likely to infer that they had the preferred Type 2 heart than would subjects who deny the attempt to shift.

## *Method*

### *Subjects*

The subjects were 21 female and 17 male undergraduates at Stanford University, participating to fulfill an introductory course requirement. Sex produced no effects and will receive no further mention.

### *Procedure*

Subjects arrived for an experiment on the "psychological and medical aspects of athletics." The experimental room was on the physiological floor of the psychology building where animals, chemicals, and electronic equipment are readily visible. The location was selected to establish credibility for our alleged interest in cardio-vascular matters. A female experimenter, wearing a white lab coat, told subjects that the purpose of the study was to examine the effects of rapid changes in temperature on heart rate after exercise. The research question was allegedly inspired by wondering what were the coronary implications of ath-

letes' jumping into a cold shower after working out on a hot day. Subjects were given an overview of the entire experimental procedure. The cold-pressor task was said to provide the necessary "change in temperature," pulse-readings to provide the measures of "heart rate," and pedalling an exercycle to provide the "exercise." Subjects understood that they would undergo two trials of the cold-pressor task, each followed by a pulse-reading, and separated from each other by a minute of exercycling. Thus the first trial would provide a baseline measure of heart rate in response to temperature change, which could then be compared to heart rate in response to temperature change following exercise. After subjects understood the procedure and were forewarned of the discomfort associated with the cold-pressor task, they were asked to express their informed consent. All subjects consented.

The baseline trial of the cold-pressor was administered after subjects had given their consent. The apparatus consisted of a picnic chest, partitioned in the middle and filled with water. Ice cubes were placed in one side of the partition, and a motor circulated the water, to maintain its temperature at about 35 F. Subjects immersed their bare hand and forearm into the water. After every five seconds they reported a number from one to ten to express their discomfort. The number ten was taken to mean that point at which subjects would rather not tolerate the cold any longer. When subjects reached ten, they were asked to remove their arm from the chest. Subjects reported their numbers in response to a letter called out by the experimenter. Subjects heard "A" after five seconds,

"B" after ten seconds, "C" after fifteen seconds, and so on. This procedure was used to help subjects to recall how long they tolerated the water on the baseline trial thus providing them with a target for the experimental trial. Subjects then had their pulse taken and pedaled an exercycle vigorously for one minute.

A brief "rest period" was inserted between the exercycling and the experimental cold-pressor trial. This interval gave the experimenter the opportunity to present the correlational structure discussed previously. To prevent subjects from discovering the true purpose of the study, the crucial information was embedded in a mini-lecture on psychophysics. Subjects learned that the cold-pressor was used to study the psychophysics of pain. Psychophysics was defined as the attempt to relate mathematically the perception of a stimulus to the physical properties of a stimulus. Subjects were shown a curve on a blackboard that related time of immersion in cold water to subjective discomfort (i.e., numbers from one to ten). The curve depicted the typical relationship and it was said to be based on data averaged over many people. Individual differences were said to exist, illustrated by showing two curves that reached ten at different rates. Skin type was said to be one factor that distinguished between people with high or low tolerance to cold water. Heart type was said to be another factor. Subjects learned that people could be characterized as having either one of two Cardiovascular Complexes, referred to as Type 1 and Type 2 hearts. Subjects viewed a histogram, on a glossy photograph, which showed that longer life expectancies were associated with increasing degrees of Type 2 hearts and that shorter life

expectancies were associated with increasing degrees of Type 1 hearts. Allegedly, some investigators had suggested that Type 1s do not differ from Type 2s in tolerance on the pre-exercise trial. However, exercise supposedly may create a difference between the two types. Subjects were then randomly assigned to either the Decrease or Increase described earlier. The information was conveyed verbally and displayed in a histogram.

A second female experimenter administered the experimental cold-pressor trial. To guard against experimenter bias, she was blind to subject's condition and performance on the baseline trial. We also tried to reduce the likelihood that subjects would show self-presentational shifts in tolerance to impress the experimenter that they were healthy. First, it was made clear to subjects that there was a lot of variability within Type 1s and Type 2s on both trials. Thus, the second experimenter could not infer from the length of the second trial subjects' likely type. Only shifts between trials would be telling. Second, subjects were assured that the first experimenter would be kept ignorant of their performance on the second trial and that the second experimenter would be kept ignorant of their performance on the baseline trial. Thus, neither experimenter would have the data required to infer subjects' likely type. Finally, the experimenter who administered the post-experimental trial was presented as a secretary, wearing ordinary clothing, employed here simply to administer the trial. Thus her appearance and behavior were designed to have it seem as though she knew nothing of the study's hypotheses, description, or rationale. After the second cold-

pressor trial, subjects completed a brief questionnaire. The questionnaire included three manipulation checks in which subjects were asked to recall which type had a longer life expectancy, which type they would prefer to be, and which type was able to tolerate cold water longer after exercise than before exercise. In addition, subjects were asked to infer whether they were Type 1 or 2, and they checked either "Yes" or "No" to the question, "Did you purposefully try to alter the amount of time you kept your hand in the water after exercise?" Finally, subjects were thoroughly debriefed of all deception and sworn to secrecy. Prior to the debriefing, no subject could articulate the hypotheses when probed.

## *Results*

### *Validity of Manipulations*

All of the 38 subjects correctly answered the questions concerning the relative lifespans and shifts in tolerance allegedly found among Type 1 and Type 2 persons. Moreover, all subjects indicated that they would prefer being Type 2.

### *Measures of Tolerance*

The number of seconds during which subjects kept their arm in the cold water was recorded after each of the two trials. The cell means are shown in Table 1. In line with our first hypothesis, subjects in the Decrease condition showed significantly less tolerance on the experimental trial than on the baseline trial, $F(1,36) = 9.41$, $p < .005$, whereas subjects in the Increase condition showed

significantly more tolerance, $F(1,36) = 23.25$, $p<.001$. The interaction between trial (baseline vs. experimental) and condition (Decrease vs. Increase) was also highly significant, $F(1,36) = 30.64$, $p<.001$, indicating that shifts in tolerance differed across the two conditions in the predicted direction.

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Insert Table 1 about here

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Of the 38 subjects tested, 27 showed the predicted shift, (13 of 19 in the Decrease condition and 14 of 19 in the Increase condition), and 11 did not, $p<.01$ by the sign test. Five subjects in each condition showed no shift, whereas one subject in the Decrease condition, a "suicidal type," showed a shift opposite from prediction.

Subjects in the Decrease condition exhibited slightly more tolerance on the baseline trial than did subjects in the Increase condition, although the difference was not statistically significant. Nevertheless, the difference raises the possibility that the observed shifts may have been due to a regression artifact. If regression could account for the results, then changes in tolerance would not differ across the two conditions in an analysis that treated baseline tolerance as a covariate. The analysis of covariance was performed, and the significant difference across conditions remained, $F(1,35) = 31.97$, $p<.001$, ruling out regression artifact.

*Self-reports*

Only 9 of our 38 subjects indicated on the anonymous questionnaire that they had purposefully tried to change the amount of time they held their hand in the water after exercise. In line with our second hypothesis, this number was smaller than the number (i.e., 29) who indicated no attempt to shift, $p<.005$ by sign test. The tendency to deny or to admit an attempt to shift could not be attributed to actual differences in behavior. That is, the percentage of subjects who did shift as predicted was no greater among subjects who indicated that they tried to shift (67%) than it was among subjects who indicated that they did not try to shift (72%). Table 2 shows the mean changes in tolerance in the Decrease and Increase conditions both for the group of subjects who indicated that they did try to shift ("non-deniers") and for the group who indicated that they did not try to shift ("deniers"). The predicted difference between conditions was significant within each group of subjects, and no interaction between condition and subjects' group was observed, $F(1,34)<1$.

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Insert Table 2 about here

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We have shown that a majority of subjects show the hypothesized shift and that a majority deny that they attempted to shift. Moreover, the deniers did not differ from the non-deniers in the degree to which their behavior was diagnostic of having a Type 2 heart. In line with our third hypothesis, however, the two groups of subjects *did* differ in their acceptance of the diagnosis implied by their behavior. Only two of the nine non-deniers (or 22%) inferred having a Type 2

heart, whereas 20 of the 29 deniers (or 69%) inferred a Type 2 heart, $p < .05$.

### *Discussion*

The preceding experiment employed a procedure that resembles a medical examination. Subjects believed that a directional change in tolerance to cold water correlated with their state of health and expected lifespan. It should have been clear to subjects that shifts in tolerance would have no *causal* impact on their life expectancy. Shifts would be merely *diagnostic* of their life expectancy in that both shifts and life expectancy were affected by an individual's heart type. As hypothesized, subjects "cheated" on this medical examination in a direction correlated with having a robust heart and long expected life. Subjects who believed that longevity was associated with an exercise-induced decrease in tolerance removed their arm from near-freezing water sooner after exercise than before exercise. Subjects who believed that longevity was associated with an exercise-induced increase in tolerance removed their arm from the water later after exercise than before exercise. The latter result indicated that people are willing to bear painful behavioral consequences so long as the behavior is a sign, though not a cause, of good health and long life.

As hypothesized, a majority of subjects indicated that they had not purposefully tried to alter the amount of time they kept their hand in the cold. Moreover, the few subjects who indicated that they did try to shift were no more likely to show the predicted shift than were the many subjects who indicated no

attempt to shift. In the post-experimental interview, the first experimenter asked subjects who shifted why they had done so. Subjects in the Decrease condition would typically say something like, "The water felt a lot colder," whereas subjects in the Increase condition would say something like, "The water just didn't feel so cold anymore." By themselves, these data may signify only that subjects were reluctant to admit to the experimenter that they had "falsified" their scores. The self-presentational account appears less plausible, however, when we consider these data in conjunction with subjects' private inferences as to whether they were Type 1 or Type 2. A majority of the subjects who indicated on the anonymous questionnaire that they tried to shift inferred that they were Type 1, fated to a life of illness. But the majority of subjects who indicated no attempt to shift inferred that they were Type 2. These inferential differences were obtained despite there being no behavioral differences between deniers and non-deniers. The data therefore suggest that a majority of subjects may have been reluctant to admit to *themselves* that they acted with a target inference in mind. Subjects probably sensed the dubious legitimacy of an inference based on behavior that was motivated by the desire to make the inference. Denying the ulterior motive makes it easier for subjects to make the comforting diagnosis. Conversely, the difficulty of denying one's intentions may help explain the limited success of behavioral therapies. Clients are trained to act assertively, but they do not feel like assertive people because they know that the behavior is a deliberate attempt to create an assertive image and is thus an invalid indicator. [1] To be sure, self deception and denial are not matters of all-or-none. Even subjects who

indicated no attempt to shift may have harbored a lingering doubt to the contrary.

The physiological mechanism of pain may have facilitated self-deception in this experiment. Most people believe that heart responses and pain thresholds are ordinarily not under an individual's voluntary control. This widespread belief would protect the assertion that the shift could not have been on purpose, for how does one "pull the strings?" For this reason, we suspect that deceptive diagnosis is more likely to occur for actions (incorrectly) believed to be uncontrollable than for actions believed to be controllable. It is also conceivable that the observed changes in cold tolerance may have reflected actual physiological changes in tolerance thresholds. Indeed, recent studies by Fields (1978) suggest that the pain relief brought about by a placebo may not be "all in the mind." The thought, "this pill will bring relief," may stimulate the production of opiate-like enkephalins. Analogously, it is not inconceivable that the motive to be Type 2 might have stimulated (Increase condition) or suppressed (Decrease condition) the release of enkephalins among subjects in the present experiment. As noted by Zimbardo and his collaborators (1969), the cognitive control of pain may be as real a phenomenon as it is perplexing.

## EXPERIMENT 2

### *Actions that Diagnose the Actions of Others: The Voter's Illusion*

The idea that people may select an action to make a favorable self-diagnosis is not new. The first experiment went beyond earlier treatments of the problem by demonstrating that self-deception may contribute to accepting the diagnosis implied by behavior. The second experiment extends our analysis of the problem further by testing the hypothesis that people would select actions correlated with auspicious outcomes, even if the actions do not directly involve inferences about oneself. For example, an individual may regard his or her own decisions as diagnostic of the decisions likely to be made by other "like-minded" persons. If the individual recognizes that beneficial outcomes would ensue if very *many* like-minded persons select a particular alternative, then the individual may select that alternative, even if the choice is costly, not witnessed by others, and not likely by itself to affect the final outcome. In these circumstances, the choice is made to 'induce' others who think and act like oneself to do the same, rather than to make comforting diagnoses about one's own attributes. The following analysis of voting is a case in point.

Political scientists have long noted the paradoxical nature of an individual's voting in large national elections. A single vote is highly unlikely to be decisive, and the time and effort required to register and vote can be considerable. To understand voting in terms of rational choice, political scientists have maintained that an individual may derive from voting other benefits than just

the prospect of casting the decisive ballot (cf. Riker & Ordeshook, 1968). These additional benefits may include fulfilling one's citizen's duty, participating in a common social ritual, and signaling to others that voting is essential for the survival of democracy. To these rational *causal* consequences of voting, we suggest adding a less rational *diagnostic* aspect. People may reason that, within the electorate, there are citizens whose political orientation is similar to theirs (i.e., like-minded persons) as well as citizens whose political orientation is dissimilar (i.e., unlike-minded persons). The political dichotomy may be based on a single important issue, like abortion, or on an entire ideology, like liberalism/conservatism. Two sets of consequences may follow from political orientation. First, like-minded persons would prefer one line of candidates, whereas unlike-minded persons would prefer the opposing line. Second, political orientation may also affect the likelihood of voting. There are three relevant possibilities to consider: like-minded persons may vote in larger numbers than do unlike-minded persons; unlike-minded persons may vote in larger numbers than do like-minded persons; or there may be no relationship between political orientation and likelihood of voting. One may not know which of these three states of the world will be in effect in the upcoming election. But one may reason that if one votes, then one's politically like-minded peers, who think and act like oneself, will also vote. Conversely, if one abstains, then one's like-minded peers will also abstain. Because the preferred candidates could defeat the opposition only if like-minded citizens vote in larger numbers than do unlike-minded citizens, the individual may conclude that he or she had better vote. That is, an individual

may regard his or her *single* vote as diagnostic of *millions* of votes, and hence as a sign that the preferred candidates will emerge victorious. This analysis of voting can be likened to a prisoner's dilemma game played by identical twins, which is a variant of the well-known Newcomb's paradox, (Nozick, 1969). The twins reason that each will eventually select the same option. Therefore, each twin should select the dominated cooperative response to "induce" the other to do the same.

To explore the plausibility of "diagnostic voting," we created a political scenario about an imaginary country named Delta, whose electorate consisted of 4 million supporters of Party A, 4 million supporters of party B, and 4 million non-aligned voters. Subjects were asked to imagine that they support Party A, and that they wonder whether it is worthwhile to vote in the upcoming election. They were presented with one of two theories about who would determine the margin of victory in the election. Both theories maintained that the victorious party would win by a margin of from 200,000 to 400,000 votes. But according to the "Non-Aligned Voters Theory," party supporters will vote in roughly equal numbers; hence the margin of victory will be determined by the non-aligned voters, who will either swing disproportionately for Party A or for Party B depending on which group of political experts one consulted. In contrast, the Party Supporters Theory held that non-aligned voters will split their vote equally between the two parties. The margin of victory would therefore depend on which of the two parties voted in greater numbers. That is, supporters of one party will

be more likely to vote than supporters of the other party, although the political experts did not agree as to which party it would be.

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Insert Figure 2 about here

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Note that the Party Supporters Theory holds that there will be a correlation between political orientation and vote turnout. That is, either the supporters of Party A will vote in greater numbers than the supporters of Party B (i.e., A>B) or vice versa (i.e., A<B). In contrast, the Nonaligned Voters Theory holds that there will be no correlation (A=B). The correlational structure expected to be generated by subjects in the Party Supporters condition is shown in Figure 2. Thus although the causal consequences of voting were held constant across the two theories, only subjects who receive the Party Supporters Theory could regard their decision to vote or to abstain as diagnostic of the decision reached by the other supporters of Party A. Because one's decision to vote would be diagnostic of a favorable electoral outcome only for subjects exposed to the Party Supporters Theory, these subjects should show a greater willingness to vote than should subjects who receive the Nonaligned Voters Theory. To test these hypotheses, we asked subjects a number of questions after they had read the respective theory, four of which assessed conditional probabilities. Assuming the theory were true, the subjects was asked how likely is it that the supporters of party A will vote in greater numbers than the supporters of party B (i.e., A > B) given that the subject votes (i.e., V) and given that the subject abstains. The

next two questions were similar in that the subject now estimated the probability of party A's defeating party B conditional on the subject's voting or abstaining. Finally, subjects were asked whether they would vote, assuming the theory were true and voting were costly. We made the following predictions:

1. The differences in inferred probabilities conditional on voting and abstaining will be greater among subjects who receive the Party Supporters Theory than among those who receive the Nonaligned Voters Theory. That is, P(A>B/V) - P(A>B/not V) will be greater in the former condition than in the latter condition, and this difference will hold for "A>B" as well as for "party A defeats party B."

2. Subjects who receive the Party Supporters Theory will indicate a greater willingness to vote than will subjects who receive the Nonaligned Voters Theory.

3 The greater the difference in inferred probabilities conditional on voting and abstaining, the greater the willingness to vote. That is, the more a subject believes that his or her voting is diagnostic of what other supporters of party A would do, the more willing is the subject to vote.

## *Method*

### *Subjects*

The subjects were 315 Stanford undergraduate volunteers.

### *Procedure*

The diagnostic voting problem was included in a questionnaire that subjects completed in their dormitories. It presented the information given in the introduction in greater detail. Subjects were asked to imagine themselves citizens of the nation, Delta, which was said to have two major opposing parties. Party A favors peace and prosperity. Party B favors offensive warfare. Subjects imagined they were supporters of party A, which consists of politically like-minded persons. Delta was about to hold an election with the presidency and other important offices being contested. A recent poll showed that 4 million eligible voters supported Party A, 4 million supported Party B, and 4 million were not aligned with either party. Subjects imagined that they were deciding whether to vote, for registering to vote in Delta is costly in time and effort. They could not ask others if they would vote, because it is considered impolite in Delta to inquire into the voting intentions of others. To facilitate the decision, they were to consult the prevailing theory about the sort of voters that determine the margin of victory for the winning party. The proponents of the theory were said to be expert political analysts.

Subjects who received the Party Supporters Theory learned that the nonaligned voters would split their votes equally between the two parties. The outcome of the election would be due to the fact that the supporters of party A will differ from the supporters of party B in how involved they become in the election. Half of the experts believed that party A supporters would become more involved than party B supporters and half believed that party B supporters would become more involved than party A supporters. All experts agreed that the party whose supporters became more involved would win by a margin of from 200,000 to 400,000 votes. The Nonaligned Voters Theory informed the remaining subjects that Party A and Party B supporters will vote in equal numbers. But the majority of the nonaligned voters will side with one unspecified party (the experts were split as to which party it would be), and that party will win by a margin of from 200,000 to 400,000 votes.

Having read the theory, subjects responded to nine questions. The first three ascertained that subjects correctly retained the relevant information. Thus subjects were asked (1) by how many votes will the winning party defeat the opposition? (2) according to the theory, which group of voters will determine the margin of victory? (3) the supporters of which party are similar to you in attitudes and behavior? The next four questions assessed the conditional probabilities hypothesized in part to motivate the vote: (1) if you vote, how likely is it that the other supporters of party A will vote in larger numbers than the supporters of party B? (2) if you abstain, how likely is it that the other supporters

of party A will vote in larger number than the supporters of party B? (3) if you vote, how likely is it that party A will defeat party B? and (4) if you abstain, how likely is it that party A will defeat party B? Responses were made on 9-point scales labelled in the middle and at the endpoints. On a similar scale, subjects were asked, "how likely are you to vote if the theory were true and voting in Delta were costly?" and, finally, subjects checked "yes" or "no" to the question, "would you vote if the theory were true and voting in Delta were costly?"

## *Results*

### *Validity of the Manipulations*

Over 93% of the subjects correctly recalled that the margin of victory would be from 200,000 to 400,000 votes and the group of voters who would determine the margin of victory. Moreover, all but one subject identified party A as the one whose supporters were similar to themselves in attitudes and behavior. Errors were distributed fairly equally across conditions, and omitting subjects who made an incorrect response does not affect the conclusions drawn from the major dependent measures.

### *Conditional Probabilities and Voting Intentions*

Each subject was asked to estimate the likelihood that Party A would vote in larger numbers than Party B if the subject voted and if the subject abstained. The subject was also asked the likelihood that Party A would defeat Party B

conditional on the subjects' voting and abstaining. The cell means are shown in Table 3, and data relevant to the predictions are found in the rows labelled "difference." As expected, the differences in inferred likelihoods conditional on voting and abstaining were significantly greater among subjects in the Party Supporters condition than among subjects in the Nonaligned Voters condition, both for the question concerning whether party A would vote in greater numbers than party B, $F(1,313) = 35.79$, $p<.001$, and for the question concerning whether party A would defeat party B, $F(1,313) = 40.18$, $p<.001$.

---

Insert Table 3 about here

---

The difference between conditions in the assumed diagnostic significance of voting translated into differences between conditions in assumed voting intentions. Subjects in the Nonaligned Voters condition assumed that they would be less willing to vote (M=6.43) than did subjects in the Party Supporters condition (M=7.17), $F(1,313)=7.85$, $p<.05$. In a like manner, a greater percentage of subjects in the former condition (16%) than in the latter (7%) indicated that they would not vote, $p<.05$. Evidence for the hypothesized linkage between the inferred diagnostic significance of voting and willingness to vote was most directly demonstrated through correlational measures. In the Party Supporters condition, subjects were more willing to vote the more they believed that their decision to vote or to abstain was diagnostic of (a) whether party A would vote in greater numbers than party B, (i.e., P(A>B/V) - P(A>B/not V)), r=.27,

$p<.001$ and (b) whether party A would defeat party B, (i.e., P(A defeats B/V) - P(A defeats B/notV)), $r=.32$, $p<.001$. In the Nonaligned Voters condition, the correlations were nonsignificantly smaller, $r=.07$, n.s. and $r=.17$, $p<.01$, respectively. That the correlations were smaller in the Nonaligned Voters condition than in the Party Supporters condition may be attributable to the smaller variance in the conditional probability differences in the former condition.

### *Discussion*

From the perspective of the individual citizen, voting is both causal and diagnostic with respect to a desired electoral outcome. Causally, a single vote may create or break a tie, and the citizen may communicate with like-minded peers, persuading them also to vote. Diagnostically, one's decision to vote or to abstain is an indicator that others who think and act like oneself are likely to make the same decision. The Party Supporters and Nonaligned Voters theories were equivalent in the causal significance of voting. But subjects perceived the Party Supporters Theory as having more diagnostic significance than the Nonaligned Voters Theory. As a consequence, they indicated a greater willingness to vote given the validity of the former theory than given the validity of the latter. These results obtained despite the margin of victory's being kept at from 200,000 to 400,000 votes for both theories, a margin that the vast majority of subjects accurately recalled.

One could identify additional circumstances, analogous to voting, in which collective action dwarfs the causal significance of a single individual's decision. The outcomes of most wars would not have changed had one fewer draftee been inducted,and the success or failure of many telethons do not hinge on the contributions of a single viewer. The paradox is that if each citizen, draftee, or viewer abstains from making his or her paltry contribution upon acknowledging its relative insignificance, then the outcomes would be dramatically affected. Indeed, the moral imperatives to vote, to fight, and to help the disabled draws its strength from the argument, "If you believe that your vote/fighting/contribution doesn't help, then consider what would happen if *everyone* felt that way." The argument is compelling. Nonetheless, just how *does* an individual's private decision materially affect the decision reached by countless other people?

### *General Discussion*

Actions may be causal or diagnostic of outcomes with which they are correlated. The normative analysis of choice maintains that, in the evaluation of alternative actions, an outcome ought to be weighted by its probability conditional on selecting the actions only if the actions have a causal effect on the outcome. We have hypothesized, however, that people may weigh an outcome by its subjective conditional probability, even though the alternative actions may be merely diagnostic of the outcome. That is, if both action and outcome are believed to be consequences of a common antecedent cause, people may reason

that by selecting the action they have increased the probability of the desirable outcome. Thus, in the first experiment, subjects selected actions correlated with longevity despite their recognizing that the actions would not affect their state of health. The actions, which were directional changes in tolerance to cold water, were mere signs that one possessed the sort of heart that would endure for longer than the normal span of years. The experiment further showed that the comforting diagnosis was accepted primarily by subjects who denied that they had purposefully tried to alter their tolerance to the cold. A certain degree of self-deception was probably involved, for otherwise the action may not have been attributed to the auspicious antecedent cause but rather to the motive to infer that cause. The second experiment demonstrated that people may make decisions diagnostic not only of their own attributes but of the decisions likely to be made by their like-minded peers. The experiment may shed light on why some people may vote in spite of the low probability of casting a decisive ballot.

We suggested that the assumed physiological mechanism of pain and heart responses may have facilitated self-deception in the first experiment. When an action is caused by factors believed to be outside an individual's voluntary control, it becomes very easy to deny to oneself that the action was deliberately enacted to make a cheerful diagnosis. That self-deception may occur more often and be more successful for actions (incorrectly) believed to be uncontrollable than controllable is an interesting question for further research. The possibility of a "motivational placebo effect," in which the desire to have one's tolerance shifted

produces actual changes in physiological tolerance thresholds, seems worth exploring.

We have argued that people often select *actions* to make favorable diagnoses. But favorable diagnoses may be reached also by varying the *circumstances* under which an action is performed. Suppose subjects in the first experiment were required to keep their arm in the cold as long on the second trial as on the first, but they were allowed to adjust the temperature of the water on the second trial. Then subjects who learned that longevity was associated with an exercise-induced increase or decrease in tolerance may have, respectively, lowered or raised the water's temperature on the second trial. That is, by making the water temperature either colder or hotter, they could still infer an increase or a decrease in tolerance without altering time of immersion. This point is reminiscent of the self-handicapping strategies discussed by Jones and Berglas (1978). These authors have argued that people may alter the circumstances of diagnostic performance to protect the belief that they are basically competent. For example, by drinking or taking drugs, any level of intellectual performance would not destroy the belief that one is basically bright, for even failure could be attributed to the debilitating effects of alcohol.

Finally, subsequent research should explicitly manipulate whether people believe an action to be causal or diagnostic of a favorable outcome. Intuitively, it appears as though the action would be chosen more often by subjects with a causal theory than by subjects with a diagnostic theory. But ironically, the

intuition may not always be valid. [2] Compare the Catholic to the Calvinist. Both believe that one's conduct on earth (virtuous or sinful) is correlated with one's post-mortal fate (paradise or hell). But the Catholic subscribes to a causal theory in which the location of one's soul after death is a direct consequence of how one led one's life on earth. In contrast, the Calvinist champions a diagnostic theory in which earthly conduct and post-mortal fate are both consequences of the deity's prior decision. Although Catholics believe they can influence the location of their life after death, whereas Calvinists believe they cannot, Calvinists may be even more motivated than Catholics to select the virtuous acts correlated with paradise. To the Calvinist, even a single sinful deed is evidence enough that he or she is not among the chosen. To the Catholic, it is more a matter of one's total good and bad deeds that determines heaven or hell. And besides, there is always confession.

*References*

Abelson, R. P., Aronson, E., McGuire, W. J., Newcomb, T. M., Rosenberg, M. J., & Tannenbaum, P. H. (Eds., *Theories of cognitive consistency: A source-book*. Chicago: Rand McNally, 1968.

Bem, D.J. Self-perception theory. In L. Berkowitz (Ed.). *Advances in experimental social psychology* (Vol. 6). New York: Academic Press, 1972.

Fields, H. Secrets of the placebo. *Psychology Today*, 1978.

Fisher, R.A. *Smoking*. London: Oliver & Boyd, 1959.

Gibbard, A., & Harper, W. L. Counterfactuals and two kinds of expected utility. In C. A. Hooker, J. J. Leach, and E. F. McClennan (Eds.), *Foundations and applications of decision theory*, Vol. I. Dordrecht, Holland: D. Reidel Publishing Co., 1978.

Gur, R. C., & Sackheim, H. A. Self-deception: A concept in search of a phenomenon. *Journal of Personality and Social Psychology*, 1979, *37*, 147-169.

Hilgard, E. R., Ruch, J. C., Lange, A. F., Lenox, J. R., Morgan, A. H., & Sachs, L. B. The psychophysics of cold pressor pain and its modification through hypnotic suggestion. *American Journal of Psychology*, 1974, *87*, 17-31.

Jeffrey, R. *The logic of decision*. New York: McGraw-Hill, 1965.

Jeffrey, R. The logic of decision defended. *Synthese*, 1981, *48*, 473-492.

Jones, E. E., & Berglas, S. C. Control of attributions about the self through self-handicapping strategies: The appeal of alcohol and the role of underachievement. *Personality and Social Psychology Bulletin*, 1978, *4*, 200-206.

Nozick, R., Newcomb's problem and two principles of choice. In N. Racher (Ed.), *Essays in honor of Carl G. Hempel.* Dordrecht, Holland: D. Reidel Publishing Co., 1969.

Riker, W. H., & Ordeshook, P. C. A theory of the calculus of voting. *American Political Science Review,* 1968, *62,* 25-42.

Skyrms, B. *Causal necessity.* New Haven, Conn: Yale University Press, 1980.

Zimbardo, P. G. *The cognitive control of motivation.* Glenview, Ill.: Scott, Foresman & Co., 1969.

## Footnotes

1 We are indebted to an anonymous reviewer for bringing this point to our attention.

2. We wish to thank Lee Ross for this idea.

**Table 1**

Mean Time of Immersion in Seconds

Trial

| Condition | Baseline | Experimental | Change |
|---|---|---|---|
| Decrease | 44.74 | 37.11 | -7.63 |
| Increase | 34.21 | 46.05 | + 11.84 |

**Table 2**

Mean Changes in Tolerance

Subjects' Self-Reported Group

| Condition | Non-Deniers | Deniers |
|---|---|---|
| Decrease | -5.00 | -8.13 |
| Increase | +19.17 | +8.08 |
| F(1,34) | 11 54 | 18.61 |
| Difference | 24.17 | 16.21 |
| p | .005 | .001 |

**Table 3**

The Inferred Likelihood of States Given Subject's Decision

| Condition | Subject's Decision | States: Party A votes in greater numbers than Party B | States: Party A defeats Party B |
|---|---|---|---|
| Party Supporters Theory | vote | 5.81 | 6.06 |
| | abstain | 4.13 | 4.09 |
| | difference | 1.68 | 1.97 |
| Nonaligned Voters Theory | vote | 4.20 | 5.12 |
| | abstain | 3.87 | 4.60 |
| | difference | 0.33 | 0.52 |

## Figure Captions

Figure 1. Illustrated causal structures.

Figure 2. Voting decisions faced by subjects in the party supporters condition.

Figure 1

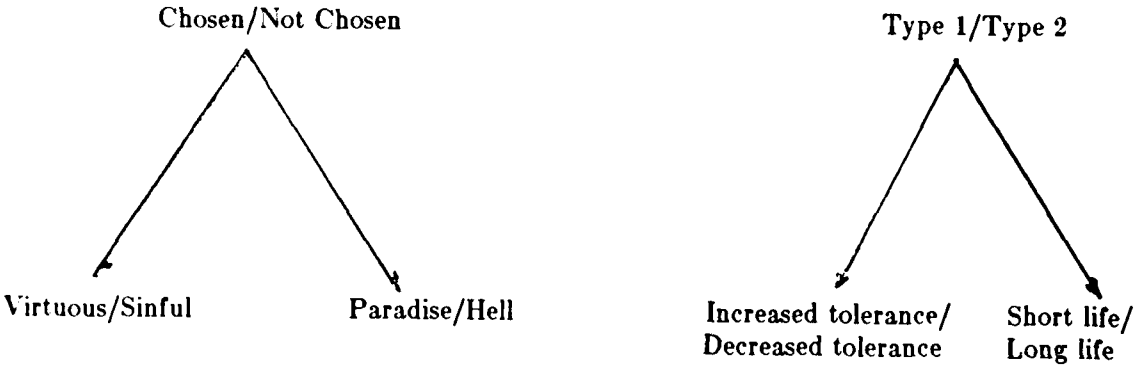
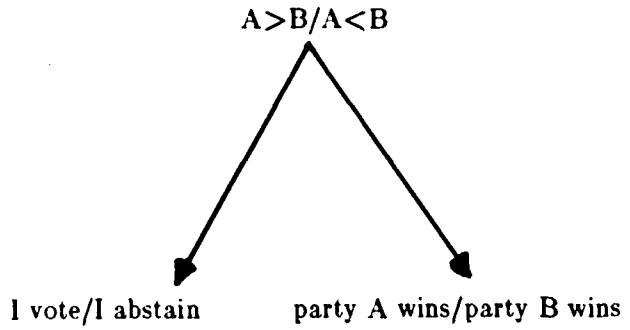

Chosen/Not Chosen
Virtuous/Sinful
Paradise/Hell
Type 1/Type 2
Increased tolerance/
Decreased tolerance
Short life/
Long life

Figure 2



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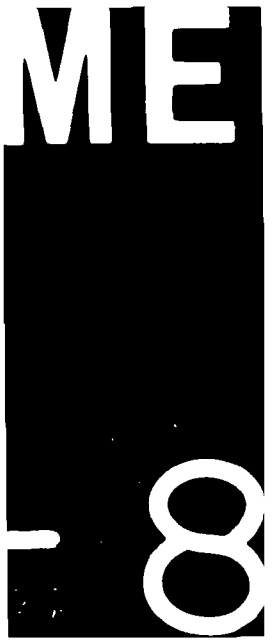
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